PERFORMANCE SPECIFICATION

for the

ELECTRO-OPTICS SENSOR (EOS)

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1. Introduction

Naval vessels require a fully integrated and seamless system that provides Anti-Terrorism Force Protection (ATFP) capabilities against asymmetric threats. The U.S. Navy has changed emphasis from open ocean "blue water" operations to that of gaining access into and operating within the littorals. U.S. Naval forces require increased force protection capability and situational awareness in the littorals, including transiting restricted waters, at anchor and pierside at ports throughout the world. Ships must rely on organic force protection capability using integrated sensor packages to provide close-range, 360°, situational awareness for detection and recognition of asymmetric threats. The Navy must increase surveillance and be prepared to intercept large numbers of small, fast surface craft, and low slow flying aircraft. Electro-optical and infrared (EO/IR) sensor systems provide needed capability for intrusion detection and threat recognition.

The primary mission of the electro-optical and infrared (EO/IR) sensor systems is to provide surface ships with a day/night, high-resolution, infrared and visible band imaging capability, as well as laser rangefinding capability, to augment existing optical and radar sensors. The primary (EO/IR) mission is to perform surveillance tasks to enhance the detection and tracking of small surface and near-surface targets such as small boats and low slow flying aircraft.

The EO sensor shall be highly reliable and capable of withstanding the Naval shipboard environment.

1.1. General Standards and Applicable Documents

The following specification, standards, and handbooks form a part of this specification to the extent specified herein. In keeping with the most recent Department of Defense and Secretary of the Navy policy, the provider is encouraged to propose alternatives to the specification and standards cited herein for government concurrence. Unless otherwise specified, the issues of the military documents are those listed in the issue of the Department of Defense Index of Specification and Standards on the date of this specification. The issue of non-government standards are those in effect on the date of this specification. Invoked documents and standards specifically called out in Section 2 and Section 3 are to be followed. Guidance documents provide a reference to use as a general guide in the development of processes, documents or data. See ***Appendix A*** for a list of standards and applicable documents that shall be considered as guidance materials.

1.2 Order of Precedence

In the event of a conflict between the text of this document and the reference cited herein, the text of this document takes precedence. Nothing in this document supersedes applicable Federal, State or Local laws and regulations unless a specific exemption has been obtained.

2. Electro-optic sensor (EOS) Top Level Requirements

The EOS shall comply with the following electrical and mechanical specifications. For the purpose of this specification the suite of electro-optic payloads and gimbal assembly is considered a single EOS unit.

PARAGRAPH NUMBER	TOP LEVEL ATTRIBUTE	THRESHOLD	OBJECTIVE
2.1	**Height**	EOS height shall be ≤ 24 inches	EOS height shall be ≤ 18 inches
2.2	**Width**	EOS width shall be ≤ 18 inches	N/A
2.3	**Depth**	EOS depth shall be ≤ 18 inches	N/A
2.4	**Weight**	EOS weight shall not exceed 74 Pounds in accordance with MIL-STD-1472F.	EOS weight shall not exceed 60 Pounds
2.5	**Power (Input)**	EOS shall be capable of running on ship's power: 115VAC ± 5% ≤ 10 Amps ± 5% 60 Hz ± 5% Single Phase Or 440VAC ± 5% ≤ 5 Amps ± 5% 60 Hz ± 5% Three Phase	N/A
2.6	**Heat Dissipation**	Above Deck Equipment: 2.3kw / 7,855 BTUs/hour Below Deck Equipment: 2.3kw / 7,855 BTUs/hour	N/A

2.7	**Sea State (Based On Pierson –Moskowitz Sea Spectrum Scale)**	Operational: EOS shall operate up to and including sea state 3. Survival: EOS shall be functional after being subjected to sea states up to and including sea states 8.	N/A
2.8	**EOS Control**	See Appendix C	See Appendix C
2.9	**EOS Interface**	EOS Interface shall be RS-232, RS-422, or Ethernet.	N/A
2.10	**Cooling/Positive Pressure**	If OEM requires, dry air shall be provided as follows: The EOS shall be cooled at ≤ 6 cfm at ≤ 100 psi. No chilled water shall be provided. No hazardous materials shall be used to keep system cool.	The EOS shall not require dry air, or desiccant packs,
2.11	**Equipment Marking**	Nameplates and markings for all pieces of equipment shall be clean, concise, legible, and durable. Markings shall be provided for all controls, lamps, switches, fuses, jacks, test points, and other components	N/A

2.12	**Radar Cross Section**	The Radar Cross Section (RCS) shall be in accordance with Radar Cross Section Requirements for IROS[3] CONFIDENTIAL/NO FORN letter dated 30 December 2002.	N/A
2.13	**BIT Diagnostics**	The EOS shall be capable of running BIT Diagnostics to determine faults within the EOS to the LRU level without the aid of separate test equipment. The EOS in BIT mode shall detect ≥ 80% of all specified faults or failures to within one LRU.	The EOS in BIT mode shall detect ≥ 90% of all specified faults or failures to within one LRU. The BIT should complete testing in ≤ 2 minutes.
2.13.1	**BIT False Alarms**	The percentage of BIT false alarms shall be ≤ 10%	The percentage of BIT false alarms shall be ≤ 5%
2.13.2	**BIT Types**	The EOS shall have a Manual BIT Test Manual BIT: A test that excludes rebooting or refreshing of default settings. This shall be an operator-initiated test.	Power-On BIT: Automatic BIT that provides diagnosis of the components during the power on procedure. The EOS shall have an Automatic BIT with a user option to bypass Automatic BIT Continuous BIT: Test that is active during regular components use. It can be triggered by momentary functions such as zoom or focus.
2.14	**Cable Diameter**	No shipboard cable shall exceed 2 Inches in diameter	No shipboard cable shall exceed 1 Inch in diameter

2.14.1	**Cable Type**	All shipboard cables shall be low smoke in accordance with MIL-C-24643B (See Appendix A).	N/A
2.14.2	**Cable Length**	All shipboard cables shall support cable runs up to and including 300 feet.	All shipboard cables shall support cable runs up to and including 1 kilometer.
2.14.3	**Shipboard Fiber Optic Cable**	If shipboard fiber optic cabling is used, it shall adhere to the specifications and requirements per MIL-STD-2042B, MIL-C-28876D, and MIL-PRF-85045F (*See Appendix A).*	N/A
2.14.4	**Shipboard Fiber Optics Spares**	If single mode fiber optic or multimode fiber optic is used in a shipboard fiber optic cable, there shall be at least a one to one ratio of fibers utilized to spare fibers in the fiber optic cable	N/A
2.15	**On-time Counter**	The EOS shall place an easily accessible and visible on time counter on all major components. The counter shall record operating hours of each major component. Counter shall be a minimum of 4 digits with minimum lowest valued digit in hours.	N/A
2.16	**Connectors**	All exterior EOS connectors shall be in accordance with MIL-STD-38999K (See Appendix A)	N/A
2.17	**Mean Time Between Failures (MTBF)**	Mean Time Between Failures (MTBF) is the predicted mean time between failures, in terms of operating hours. MTBF shall be calculated by the following formula: MTBF = Average Uptime/Number of Failures The EOS shall have a MTBF = 720 hours	The EOS shall have a MTBF = 1440 hours

2.18	**Mean Time To Repair (MTTR)**	Mean Time To Repair (MTTR) is the predicted mean time to repair the item, in elapsed hours. This factor is used to compute A_o of the equipment and to provide estimates of maintenance shop workloads. The EOS shall have a MTTR ≤ 1 hour	The EOS shall have a MTTR ≤ 30 minutes
2.19	**Equipment Finish**	All equipment shall be Navy Haze Gray, Color #26270 per FED-STD-595B *(See Appendix A),* Per one of the following: Hard coat anodize per MIL-STD-810F, type III, class1 or, Commercial grade powder coat epoxy with appropriate priming system	N/A
2.20	**Environmental**	The EOS shall Meet the Environmental Requirements In Appendix B	N/A
2.21	**UID Tag**	The EOS shall have Unique IDentification (UID) tags at the LRU level Government shall provide UID tag part numbers prior to production of the EOS.	N/A
2.22	**Safety**	The EOS shall be designed to ensure the system is safe to use, and there shall be no electrical, mechanical, or radiation hazard to users as specified in MIL-STD-882D.	N/A

2.23	**Maintenance Level**	Organizational: The EOS shall provide an LRU level of corrective and preventative maintenance to be performed by ship's force. This shall include the utilization of BIT. The EOS shall be designed to minimize the requirement for preventative maintenance. Intermediate: The EOS shall not require intermediate level maintenance at the system level Depot: The EOS shall require depot level maintenance only for items that have been agreed to by the Government as being non-repairable by the ship's force. The OEM shall perform depot level maintenance.	N/A
2.23.1	**Maintenance Test Equipment**	Organizational level preventive/corrective maintenance shall not require any special purpose test equipment. General-purpose test equipment is allowed if necessary.	N/A
2.24	**Local Kill Switch**	The EOS shall be equipped with a local kill switch that shall secure the power during manual troubleshooting or manipulation of the gimbal.	N/A
2.25	**System Feedback**	The EOS shall contain component sense lines that provide system feedback concerning operation of the sensor.	N/A

2.26	**Fiber Cable Interconnect**	N/A	All EOS fiber equipment shall utilize International Fiber Systems hardware, and shall be configured prior to delivery.
2.27	**Noise Level**	The EOS audible noise level shall be no louder than 63 decibels in accordance with MIL-STD-710-1, Grade A3.	N/A

3. EO Sensor Description

As a minimum, the EOS shall consist of a stabilized gimbal containing the following payloads: daylight imaging television sensor (TVS), a forward-looking infrared sensor (FLIR), an eye-safe laser range-finder (ESLRF), and a spotter scope.

3.1 Stabilized Gimbal Performance Thresholds and Objectives.

The Stabilized Gimbal shall meet the performance requirements as outlined below.

3.1.1 Stabilized Gimbal Requirements

The Stabilized Gimbal shall provide Line of Sight (LOS) capabilities as stated in Table 2.

Table 2 **Stabilized Gimbal Requirements**

Characteristic	Requirement	
	Threshold	Objective
Azimuth Field of Regard	360° continuous	NA
Elevation Field of Regard	–120° to +90°	–135° to +105°
Bearing Slew Rate and Acceleration Rate	= 60 deg/sec	= 75 deg/sec
LOS Jitter	LOS Jitter ≤ 35 micro-radians	LOS Jitter ≤ 20 micro-radians
Vibration/Isolation	2 axes (Azimuth and Elevation)	3 axes(must include Azimuth and Elevation axes)
Gimbal/Gyro Drift	EOS shall be able to correct for gimbal/gyro drift via software. After correction, the gimbal shall not drift again for at least 1 hour.	EOS shall be able to correct for gimbal/gyro drift via software. After correction, the gimbal shall not drift again for at least 4 hours.
Boresight Characteristics	EOS shall be able to verify and correct bore sight errors. Boresight retention interval shall be at least 8 hours. EOS shall retain the reticle position of the last boresight before power-down and restore the reticle to that position without operator intervention on power-up.	EOS shall be able to verify and correct bore sight errors. Boresight retention interval shall be at least 12 hours. EOS shall retain the reticle position of the last boresight before power-down and restore the reticle to that position without operator intervention on power-up.

Boresight Accuracy	< 4 milli radians	< 2 milli radians
Window Heater	N/A	EOS shall have window heater(s) to remove exterior moisture accumulation

3.1.1.1 Ship Motion Parameters

As an objective the EOS shall meet performance requirements under the ship motion parameters outlined in Table 3.

Table 3 **Ship Motion Parameter Performance Objectives**

Ship Motion	Objective	Performance
Roll	11 second period 0° to 15° port and starboard 15° to 30° port and starboard 30° to 45° port and starboard	without operational degradation with operational degradation without damage
Pitch	7 second period Between 0° and 5°	without operational degradation
Yaw	7 second period between –5° and +5°	without operational degradation
Turning Rate	2° per second	without operational degradation
Roll, Pitch and Yaw are Sinusoidal and Non-synchronous		
TEST METHOD:MIL-HDBK-2036		

3.2 Sensor Requirements

3.2.1 FLIR Sensor Requirements

FLIR Sensor shall meet capabilities as stated in Table 4.

Table 4: FLIR Sensor Requirements:

Characteristic	Requirement	
	Threshold	Objective
Thermal Imaging Sensor(s) IR Band	midwave IR band (nominally 3-5 μm)	N/A
NETD (deg C)	≤ 0.05	≤ 0.025
Thermal Imaging Sensor FOV	WFOV ≥ 35° 17.5° ≤ MFOV ≤ 20.5° NFOV ≤ 0.9° or variable FOV (wide to narrow) (horizontal field of view)	Threshold FOVs With At Least 2 Additional FOVs With The Following Characteristics: 26° ≤ WMFOV ≤ 30.5° 9° ≤ MNFOV ≤ 11° (horizontal field of view) -or- Continuous zoom between the Threshold WFOV and NFOV (horizontal field of view)
Narcissus Effect	Narcissus effect shall not be visible in the observed image	N/A

The FLIR Sensor shall provide:

(a) black hot/white hot polarity;
(b) automatic gain and level control; and
(c) manual gain and level adjustments
(d) ability to calibrate FLIR sensor through software.

At minimum, full FLIR operational performance shall be achieved in < 10 minutes (threshold), with a goal of < 8 minutes (objective).

3.2.1.1 FLIR Resolution and Sensitivity

The resolution thresholds and objectives were determined using a 7m RHIB, radial inbound, with 0.75 degree delta-T, in "very poor" weather (i.e. 90% point of the R384 environmental database). The standard 2D Johnson criteria for detection and identification shall apply. Additionally the range at which the discrimination task is required to be performed was extended as follows:

- Detection Threshold – As a threshold, the probability of detection (i.e. operator confidence) for above 7m RHIB shall be greater than 90% at a range greater than or

equal to 4000 yards. This range equates to the maximum objective programmable Surface Warfare intruder keep out region.

- Detection Objective – As an objective, the probability of detection (i.e. operator confidence) for above 7m RHIB shall be greater than 90% at a range greater than or equal to 6000 yards. This range equates to the maximum objective programmable Surface Warfare intruder keep out region.

- Identification Threshold – As a threshold, the probability of identification (i.e. operator confidence) for above 7m RHIB shall be greater than 90% at a range greater than or equal to 1000 yards. This shall allow the operator to successfully perform the discrimination task against various surface targets in various environments.

- Identification Objective – As an objective, the probability of identification (i.e. operator confidence) for above 7m RHIB shall be greater than 90% at a range greater than or equal to 2000 yards. This shall allow the operator to successfully perform the discrimination task against various surface targets in various environments.

3.2.2 Daylight TVS Camera:

The TVS shall be a CCD color camera and shall meet the requirements in Table 5.

Table 5

Characteristic	Requirement	
	Threshold	Objective
TVS Sensitivity	0.5 lux to 2000 lux	0.2 lux to 2000 lux
TVS Resolution	≥ 470 NTSC	NA
TVS FOV (color)	WFOV ≥ 17° NFOV ≤1.7° With continuous zoom	WFOV ≥ 25° NFOV ≤1.0° With continuous zoom

3.2.3 Spotter Scope Requirements

As a threshold, the spotter scope shall be a CCD color camera and shall meet the requirements in Table 6.

Table 6

Characteristic	Requirement	
	Threshold	Objective
Spotter Scope Sensitivity	0.5 lux to 2000 lux	0.2 lux to 2000 lux
Spotter Scope Resolution	≥ 470 NTSC	NA
Spotter Scope FOV (color)	FOV ≤ 0.4°	NA

3.2.4 Eye Safe Laser Range Finder Requirements

The EyeSafe Laser Rangefinder (ESLRF) shall have the following characteristics:

(a) Be Class 1 eyesafe in accordance with ANSI Z136.1-2000;
(b) Nominal Ocular Hazard distance for the unaided human eye shall be zero;
(c) Be able to range targets at 14,000 meters;
(d) Threshold Range accuracy of $\pm$ 5 meters, Objective Range accuracy of $\pm$ 2 meters;
(e) Display range in nautical miles, statute miles, meters, yards, and/or feet;
(f) Range display shall not display a numerical range for no return situations but shall provide an indicator to the Operator that no return occurred.

The output power of eyesafe laser shall be such that the Nominal Ocular Hazard Distance (NOHD) as defined by ANSI Z136.1-2000 shall be 0 meters under optically aided as well as unaided viewing conditions. The aided viewing condition is defined as $\leq$ 20 times magnification. The output power of the eyesafe laser shall not exceed the maximum permissible exposure limit for ANSI Class 1, and shall be certified as eyesafe by a U.S. Navy Laser Safety Review Board following the guidance of ANSI Z136.1-2000.

3.2.5 Automatic Video Tracker (AVT) Requirements

The AVT shall have the following characteristics:

The EOS shall have an AVT capability that can accept video from either the FLIR or the TVS, as selected, and automatically or manually track contacts from the video signal. The EOS shall have the ability to acquire and track stationary, crossing, and maneuvering contacts. As a threshold, the EOS shall automatically re-establish auto-track on contacts through changes of sensor FOV. An electro-optic sensor shall be capable of auto-tracking a single contact within the FOV and have an objective of dual contact tracking within a FOV.

As a threshold, the AVT shall have at least two distinct modes of tracking to optimize tracking under various environmental and contrast conditions. As an objective, the AVT shall automatically select the best tracking mode based on environmental and contrast conditions.

As a threshold, the AVT shall track closed contour regions of contrast in the image. The AVT shall be able to acquire and track the contact ranging in size from 1% to 75% of the currently commanded FOV when the LOS to the contact is not obscured. After a contact has been acquired, the AVT shall be able to maintain track on a contact as small as 0.5% of the FOV dimension.

As an objective, an AVT coast function shall be provided that shall allow a contact that has been obscured, to be automatically re-acquired if the same contact becomes unobscured within 3 seconds.

3.2.6 Mounting Requirements

The EOS shall include all the necessary mounting hardware to allow the EOS to be easily and safely installed and made fully operational. The EOS shall be capable of being mounted in an upright or inverted position. The EOS shall have removable handles to assist in Installation/ De-installation of the EOS.

3.2.7 EOS Environmental Requirements

In order to perform the surface Navy mission, the EOS shall operate in the open ocean and littoral environment, and shall be subjected to a severe marine weather environment. The EOS shall operate and be maintained in the environmental extremes as specified in Appendix B without degradation to mechanical capabilities or material condition. The EOS shall meet the environmental requirements of Appendix B.

3.2.8 Electromagnetic Compatibility (EMC) Requirements.

The EOS shall be electro magnetically compatible with all shipboard systems/equipments, and shall not degrade, nor be degraded by, own-ship systems. The EOS shall meet the EMI/EMC requirements of Appendix B.

3.2.9 Shock and Vibration

The EOS shall meet the Shock and Vibration requirements of Appendix B.

4. Ancillary Equipment

This specification has been written with the intent of only documenting requirements for a single EOS unit (EOS and gimbal assembly if required). As an objective, ancillary equipment to support the EOS shall not be required. As a threshold, ancillary equipment is permissible to support the EOS unit. Ancillary equipment shall be evaluated in conjunction with the EOS requirements. Preference shall be given in regards to the ancillary equipment in the following order: no ancillary equipment, 19” rack mountable ancillary equipment, bulkhead mountable ancillary equipment. Less ancillary equipment shall have preference over more ancillary equipment, and smaller/lighter ancillary equipment shall have preference over larger/heavier ancillary equipment.

It is anticipated that this component shall be integrated into a larger ship system. As such, it is not anticipated or desired that ancillary equipment (such as hand controllers, displays, shipboard cables, etc...) be provided as part of this contract. As a threshold shipboard cable drawings shall be provided with enough detail for the IROS^3 system integrator to build independently.

5. Acronym Definitions

Amps	Amperes
A_O	Operational Availability
ATFP	Anti-Terrorism Force Protection
AVT	Automatic Video Tracker
BIT	Built In Test
BTU	British Thermal Unit
CCD	Charge-Coupled Device
COTS	Commercial-Off-The-Shelf
EMI/EMC	Electromagnetic Interference/ Electromagnetic Compatibility
EO/IR	Electro-optical and Infrared
EOS	Electro-optic Sensor
ESLRF	EyeSafe Laser Rangefinder
FOV	Field Of View
GFE	Government Furnished Equipment
ID	Identification
IROS^3	Integrated Radar Optical Surveillance and Sighting System
kw	Kilowatts
LAD	Large Area Display
LCD	Liquid Crystal Display
LOS	Line Of Sight
LRU	Lowest Replaceable Unit
MTBF	Mean Time Between Failures
MTBMCF	Mean Time Between Mission Critical Failures
MTTR	Mean Time To Repair
NOHD	Nominal Ocular Hazard Distance
NSWC	Naval Surface Warfare Center
NTSC	National Television Standards Committee
OEM	Original Equipment Manufacturer
PC	Personal Computer
PCI	Peripheral Component Interconnect
PSI	Pounds Per Square Inch
POSIX	Portable Operating System Interface
RFID	Radio-Frequency Identification
RCS	Radar Cross Section
SOW	Statement Of Work
SUW	Surface Warfare
SPS	Shipboard Protection System
TBD	To Be Defined
TVS	Television Sensor
UPS	Un-interruptible Power System
VAC	Volts AC

Appendix A

MIL-HDBK-2036	01 NOV 1999	Preparation Of Electronic Equipment Specifications
Federal Acquisition Register	JAN 1998	Y2K Document
MIL-HDBK-46855A	17 MAY 1999	Human Engineering Requirements For Military Systems, Equipment, And Facilities
MIL-STD-2525B	30 JAN 1999	Common Warfighting Symbology
MIL-DTL-38999K	12 JUL 2002	Connectors, Electrical, Circular, Miniature, High Density, Quick Disconnect (Bayonet, Threaded, And Breech Coupling), Environment Resistant, Removable Crimp And Hermetic Solder Contacts, General Specification For
MIL-DTL-5015H	18 MAY 2000	Connectors, Electrical, Circular Threaded, AN Type, General Specification For
MIL-C-24643A	14 MAR 1994	Cable And Cords, Electric, Low Smoke, For Shipboard Use, General Specification For
MIL-STD-2042B	25 JUL 2002	Fiber Optic Cable Topology Installation Standard Methods For Naval Ships
MIL-C-28876D	04 MAY 1995	Connectors, Fiber Optic, Circular, Plug And Receptacle Style, Multiple Removable Termini, General Specification For
MIL-PRF-85045F	12 AUG 1999	Cables, Fiber Optics, (Metric), General Specification For
FED-STD-595B	11 JAN 1994	Colors Used In Government Procurement

MIL-A-8625F	10 SEP 1993	Anodic Coatings For Aluminum And Aluminum Alloys
MIL-STD-810F	30 AUG 2002	Department Of Defense Test Method Standard For Environmental Engineering Considerations And Laboratory Tests
MIL-STD-167/1	19 JUN 1987	Mechanical Vibrations Of Shipboard Equipment (Type 1 – Environmental And Type II - Internally Excited)
MIL-S-901D	17 MAR 1989	Shock Tests. H.I. (High Impact) Shipboard Machinery, Equipment, And Systems, Requirements For
DOD-STD-1399/70-1	30 NOV 1989	Interface Standard For Shipboard Systems Section 070 - Part 1 D.C. Magnetic Field Environment (Metric)
MIL-STD-461E	20 AUG 1999	Requirements For The Control Of Electromagnetic Interference Characteristics Of Subsystems And Equipment
OPNAVINST 3000.12	30 SEP 1999	Operational Availability Handbook
MIL-STD-882D	10 FEB 2000	Standard Practice For System Safety
MIL-STD-1399-300A	11 MAR 1992	Interface Standard For Shipboard Systems Section 300A Electric Power, Alternating Current (Metric)
MIL-STD-1472F	23 AUG 1999	Department Of Defense Design Criteria Standard, Human Engineering
ANSI Z136.1-2000	26 OCT 2000	Safe Use Of Lasers
CONFIDENTIAL/NO FORN	30 DEC 2002	Radar Cross Section (RCS) Requirements For Integrated Radar Optical Surveillance And Sighting System ($IROS^3$)

ENVIRONMENTAL SPECIFICATIONS (OPERATING)			
Ambient Temperature	-28 °C to 65 °C	MIL-STD-810F Method 501.4 and 502.4, Procedure II	Above Deck Equipment
Ambient Temperature	0 °C to 50 °C	MIL-STD-810F Method 501.4 and 502.4, Procedure II	Below Deck Equipment
Storage Ambient Temperature	-40 °C to 70 °C	MIL-STD-810F, Method 501.4 and 502.4, Procedure I	Above Deck Equipment And Below Deck Equipment
Solar Radiation	350 BTU/hr/ft^2	MIL-STD-810F, Method 505.4, Procedure II, Basic Hot	Above Deck Equipment
Rain	Rainfall rate 6 cm/hr, wind speed 18 m/s, water pressure 377 kPa	MIL-STD-810F, Method 506.4 Procedure I (Blowing rain).	Above Deck Equipment
Humidity	100% condensing	MIL-STD-810F, Method 507.4	Above Deck Equipment And Below Deck Equipment
Salt Fog	MIL-STD-810F, Method 509.4 Procedure I	MIL-STD-810F, Method 509.4 Procedure I	Above Deck Equipment And Below Deck Equipment
Ice	4.5 lbs/ft^2	MIL-STD-810F, Method 521.2 Procedure I	Above Deck Equipment
Fungus	MIL-STD-810F, Method 508.5	MIL-STD-810F, Method 508.5	Above Deck Equipment And Below Deck Equipment
Sand/Dust	MIL-STD-810F, Method 510.4 Procedure I (Blowing Dust)	MIL-STD-810F, Method 510.4 Procedure I (Blowing Dust)	Above Deck Equipment
Wind velocity	90 knots	To be incorporated into design and supported by analyses	Above Deck Equipment
Vibration	MIL-STD-16711 Type 1 and MIL-STD-810F, Method 514.5 Category 9 (Shipboard vibration)	MIL-STD-167-1 Type 1 and MIL-STD-810F, Method 514.5 Category 9 (Shipboard vibration)	Above Deck Equipment And Below Deck Equipment
Shock	Grade A, Type A, Class III	MIL-HDBK-2036 (Shock); MIL-S-901D	Above Deck Equipment
Shock	Grade A, Type A, Class III	MIL-HDBK-2036 (Shock); MIL-S-901D	Below Deck Equipment
DC Magnetic Field	DOD-STD-1399-70-1	DOD-STD-1399-70-1	Below Deck Equipment
Non-Operating Altitude	MIL-STD-810F, Method 500.3 Procedure I	MIL-STD-810F, Method 500.3 Procedure I	Above Deck Equipment And Below Deck Equipment
EMI/EMC	MIL-STD-461E class A4	MIL-STD-461E class A4	Above Deck Equipment And Below Deck Equipment

Appendix B

Appendix C

2.8 EOS CONTROL REQUIREMENTS			
PARAGRAPH NUMBER	**TOP LEVEL ATTRIBUTE**	**THRESHOLD**	**OBJECTIVE**
2.8.1	**EOS Power On/Off**	EOS shall be able to receive a remote message to turn EOS on/off	EOS shall be able to receive a remote messge to turn EOS on/off and give an EOS on/off status
2.8.2	**EOS Positional Data**	EOS shall give current positional data (elevation and azimuth) at the rate of $\leq$ 50 msec	EOS shall give current positional data (elevation and azimuth) at the rate of $\leq$ 33 msec EOS shall provide a positional data accuracy of $\leq$ 1 milli-radian(s)
2.8.3	**EOS Movement Commands**	EOS shall receive variable slew rate commands for both azimuth and elevation axis	EOS shall receive variable slew rate commands for both azimuth and elevation axis EOS shall move to a commanded azimuth and elevation
2.8.4	**EOS Status Reports**	EOS shall periodically update ($\leq$ 50 msec) status	EOS shall periodically update ($\leq$ 33 msec) status and be able to give status report when queried
2.8.5	**EOS Stow Position**	EOS shall have a configurable stow position	N/A
2.8.6	**EOS Software Updates/Upgrades**	EOS shall have the capability to receive software updates and upgrades	N/A
2.8.7	**EOS Software Stops/Keep-out Zones**	EOS shall have programmable software stops/keep-out zones	N/A
2.8.8	**EOS BIT**	EOS BIT shall communicate with software when a fault occurs detailing what fault occurred	N/A
2.8.9	**EOS Auto Null**	The drift of the EOS shall be capable of being zeroed out by software	N/A
2.8.10	**EOS Feedback**	EOS shall provide feedback for all commands from software	N/A

2.8.11	**EOS Field Of View (FOV)**	EOS shall receive FOV commands in either FLIR mode or TVS mode	EOS shall receive FOV commands in either FLIR mode or TVS mode EOS shall receive FOV commands and report current FOV setting in either FLIR mode or TVS mode
2.8.12	**EOS FLIR Polarity**	Software shall change the polarity of the FLIR setting on the EOS	Software shall change the polarity of the FLIR sensor FLIR sensor shall report current polarity settings
2.8.13	**EOS Focus**	Software shall change the focus of the EOS	Software shall change the focus of the EOS EOS shall report current focus settings
2.8.14	**EOS Gimbal Mode**	Software shall be able to change the mode of the EOS gimbal; at a minimum, modes shall include Rate Control, and Stow	Software shall be able to change the mode of the EOS gimbal; at a minimum modes shall include Rate Control, Stow, and Position The EOS shall report which mode it is in
2.8.15	**EOS Interface Protocol**	EOS interface protocols shall be fully disclosed	EOS interface protocols shall be fully disclosed and non-proprietary
2.8.16	**EOS Iris Mode**	EOS iris shall be controllable by software to change between automatic and manual modes Means shall be provided for control of the iris when in manual mode	EOS iris shall be controllable by software to change between automatic and manual modes Means shall be provided for control of the iris when in manual mode EOS shall report current iris settings

2.8.17	**EOS Laser Fire**	EOS laser range finder shall be able to be fired by software and return a range	EOS laser range finder shall be able to be fired by software and return a range EOS shall have a quality of return indication in the laser range
2.8.18	**EOS Mode**	Software shall switch between the EOS camera devices, including FLIR, TVS, and Spotter Scope	Software shall switch between the EOS camera devices, including FLIR, TVS, and Spotter Scope EOS shall report which mode EOS is in
2.8.19	**EOS Payload On/Off**	EOS shall be able to receive a remote message to turn any of the four EOS payloads on/off	EOS shall be able to receive a remote message to turn any of the four EOS payloads on/off and give individual EOS payload on/off status
2.8.20	**EOS Stabilization Mode**	Software shall have the ability to toggle EOS stabilization on/off	Software shall have the ability to toggle EOS stabilization on/off EOS shall provide feedback on EOS stabilization mode
2.8.21	**EOS Tracking**	EOS tracking shall be on/off controllable by software	EOS tracking shall be on/off controllable by software EOS shall be capable of scanning defined areas and auto-tracking a contact, configurable by software interface EOS shall report EOS tracking status